Associations between Social Media Use and Psychological and Biological Stress in Adolescents

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Abstract

Research on the relationship between social media use and stress has reported both positive and negative correlations; greater use was associated with increased stress in some studies and decreased stress in others. Self-reported measures of perceived stress have been more commonly examined in studies than biological measures. The purpose of this study was to explore the associations between self-reported perceived stress and biological stress measured using hair cortisol – a longer term measure of average cortisol levels over time as 1 cm of hair approximates 1 month of average cortisol output. Secondary data was examined using a representative sub-sample of 600 adolescents from the first wave of the Adolescent Health and Development in Context study – a prospective cohort study conducted in Franklin County, OH. The independent variable was frequency of adolescent social network use (several times a day [reference], about once a day, several times a week, and several times a month). The dependent variables were perceived stress (Cohen's Perceived Stress Scale) and biological stress (hair cortisol). Descriptive statistics were conducted to examine sample characteristics and bivariate regression analyses were utilized to examine associations. Adolescents on corticosteroids; missing data on social media use, stress or steroid use; or who had out of range cortisol levels were excluded for analysis for an analytic sample of 486 adolescents. Sensitivity analysis was conducted in which adolescents on corticosteroids or missing data on steroid use were not excluded; findings were comparable between the

two samples. In the descriptive statistics, 59.3% of adolescents reported using social media several times a day. In the bivariate regression analysis, perceived stress was lower for youth who visited social network sites several times a month (b= -0.22, p= 0.0492), several times a week (b= -0.32, p= 0.0044), and approximately once a day (b= -0.34, p= 0.0002) in comparison to those who visited sites several times a day. There were no significant findings between frequency of use and hair cortisol. The findings suggest less frequent social media use is associated with lower levels of perceived stress; however, non-significant associations were found with hair cortisol. Potential reasons for the disparate findings between the measures may be due to differences between perceptions and biology as well timing of the measures. In addition, multivariable analysis in which potential confounding measures are included is needed as well as consideration for potential sex differences in the relationships.

Introduction

Social media use has increased significantly among adolescents over the past decade. New technological advancements have made it easier for adolescents to access various social media platforms such as Facebook, Instagram, Twitter, Snapchat, Pinterest, etc. According to a Pew survey that was conducted in 2018, 94% of teenagers who go online with a mobile device access social media daily, which is a 22% increase from the 73% of teenagers that reported doing so in 2014-2015 (Pew Research Center, 2018). Furthermore, about half (51%) of U.S. teenagers reported that they use Facebook (Pew Research Center, 2018). Social media is the most prominent communication tool for adolescents, and a high percentage of adolescents engage in frequent social media use on a daily basis. The easy accessibility also makes it easier for adolescents to connect and engage in persistent online activities; 95% of teenagers reported having a smartphone and 45% said they are online on a consistent basis (Pew Research Center, 2018). This likely results from the level of fulfillment adolescents receive from the space as it provides opportunities for creative expression (posting original videos, essays, or poems) and social exploration (Gerwin et al., 2018).

Studies have found that social media use may have negative as well as positive effects on adolescent mental health and wellbeing. For example, Lin et al. (2016) found that young adults in the U.S. who spent 2 or more hours a day using social media reported significantly more depressive symptoms compared to their peers who spent 30 minutes or less. Moreover, in a recent review of the literature, heavy social media/Internet use was associated with increased suicide attempts; cyberbullying victimization and sleep disturbance accounted for some, but not all, of the relationship. In

another review (Lissak, 2018), increased screen time was found to be associated with decreased social coping (supportive and positive communication with people face-to-face), less social support and attachment with friends and family, and increased craving behavior, both of which are very similar to substance dependence behaviors. Although social media addiction is not yet classified as a formal nor a real diagnosis, the number of people utilizing social networks continue to drastically increase. However, studies have also shown that there's a significant positive association between internet usage and mental health. For example, a study performed by Cotten et al. (2012) found that increased internet use correlated with a decreased incidence of depression. Additionally, another study found that having a cell phone or Internet connection at home increases one's well-being (Kavetsos & Koutroumpis, 2011).

In addition to the negative effects of increased social media use on psychological distress, studies have also found associations with biological stress. Salivary cortisol, under the control of the hypothalamic-pituitary-adrenal (HPA) axis, has been examined most frequently and the findings of these studies suggest increased social media use is associated with increased salivary cortisol levels. For example, a study found that, in adolescents, greater phone use, general social media use, and larger social networks had a greater rise in their salivary cortisol awakening response compared to their peers with less social media use and smaller social networks (Afifi, Zamanzadeh, Harrison, & Acevedo, 2018). Others found that salivary cortisol levels decreased when adolescents took a break from using Facebook (Vanman, Baker, & Tobin, 2018). Another study found that salivary cortisol levels were positively associated with the number of Facebook friends and negatively associated with Facebook peer-interactions, such as

positive social support from their network (Morin-Major, Marin, Durand, Wan, Juster, & Lupien, 2016). However, the study found no significant associations between frequency of Facebook use and cortisol levels.

While salivary cortisol is useful to measure acute or short-term biological stress responses, the measure does not capture longer term or chronic stress as well (Hellhammer, Wüst, & Kudielka, 2009). Salivary cortisol only reflects HPA activity over a restricted time period; it provides a snapshot of HPA activity that is subject to circadian variation (Meyer & Novak, 2011). Examination of hair for cortisol has been increasingly used to measure longer term cortisol stress responses as hair grows approximately 1 cm a month, thus 1 cm of hair estimates the average cortisol level over the corresponding 1 month time frame (Russel, Koren, Rieder, & Uum, 2012). As the effects of social media use on chronic biological stress is understudied, this research explored the associations between the frequency of adolescents' social media use and their self-reported perceptions of stress as well as longer term measures of biological stress using hair cortisol.

Methods

Study design and sample

The study used existing data from a subsample (N=600) of adolescents aged 11 to 17 years who participated in the first wave of the *Adolescent Health and Development in Context* (AHDC) study - a prospective cohort study conducted in Columbus, OH and the surrounding suburbs (N=1401). Trained interviewers collected data in the home setting using face-to-face interviews and a self-administered survey for sensitive questions. The interview contained questions regarding the participants' sociodemographic history,

family, behaviors, romantic relationships, physical activity, emotions, smoking history, drug usage history, criminal and abuse history, religion, attitudes, school involvement, relationships with friends, physical developments, values and beliefs, mental health history, and social media usage. Biological markers of stress, including hair cortisol, were also collected among the youth participating in the AHDC study. The hair (approximately 10mg to 50 mg) was collected using thinning shears by the interviewer from the participants' posterior vertex region of the scalp. Hair was stored at room temperature until assay.

Adolescents on corticosteroids (oral, inhaled, nasal and topical) or missing data on corticosteroid use were excluded from the analysis due to their effect on cortisol levels (n=46) as were those who had cortisol levels outside of the normal range (n=33). In addition, adolescents were excluded it they were missing data on any of the perceived stress scale items (n=1) as well as frequency of social media use (n=34). The analytic sample size for the study was N=486. Sensitivity analysis was conducted in which adolescents who were on corticosteroids or who were missing data on corticosteroids were not excluded; the findings between the two samples were comparable with respect to the direction of the relationships and the p-values.

Measures

Frequency of social media use: Participants were asked how often they visited social networking sites with response options ranging from: several times a day, about once a day, 3 to 5 times a week, 1 to 2 times a week, every few weeks, or less than a month. Due to small samples sizes, several response categories were collapsed. For the analysis, visiting social network sites about once a day, several times a week, and once to several

times a month were compared to the reference category of visiting social network sites several times a day.

Perceived stress: Participants were asked about their global stress perceptions using 9 items from the Cohen's Perceived Stress Scale, which has a coefficient alpha reliability ranging from 0.84 and 0.86 (Cohen et al., 1983). The items assessed stress perceptions over the prior month and the response options were on a 5-item Likert scale ranging from never to very often with higher scores indicating greater perceived stress. Some of the questions include "In the last month… how often have you felt that you were unable to control the important things in your life?" and "… how often have you been upset because of something that happened unexpectedly?" (Cohen et al., 1983).

Biological stress: One to three cm of hair was processed and assayed using Salimetrics^{R} cortisol immunoassay at the Ohio State University College of Nursing Stress Science Lab using adapted protocol developed by Meyer et al., 2014. Samples were assayed in duplicate and inter- and intra-assay coefficients of variation were <10%. The My Assay^{R} analytic software program using the Salimetrics^{R} protocol was used to calculate the cortisol levels in μg/dL and then converted to pg/mg using the formula provided by Meyer et al. (2014). Cortisol levels were skewed and log transformed for analysis.

Data Analysis

Univariate statistics were conducted to describe the characteristics of the study sample, including the frequency of use as well as the type of platforms adolescents most commonly accessed. Bivariate data analysis was then conducted to examine the associations between frequency of social media use and perceived stress as well as between social media use and biological stress (logged hair cortisol levels). We

conducted an additional sensitivity analysis in which we controlled for hair length in a multivariable regression and findings were comparable to the bivariate results.

Results

Sample Characteristics and Descriptive Results

The sample consisted of 486 adolescents between the ages of 11 and 17 years old with hair cortisol data and no missing responses on the other variables. This was a racially and socioeconomically representative sample of youth residing in metropolitan Columbus, Ohio and the surrounding suburbs (Table 1). Of the sample, 59.31% of the adolescents used social media several times a day, 15.55% used it about once a day, 9.02% used it several times a week, and 9.60% used it several times a month. Furthermore, of the sample, 95.06% reported to using social network sites and of these, 57.61% used Facebook, 49.38% used Twitter, 72.84% used Instagram, 4.94% used Myspace, 68.31% used YouTube, 20.37% used Tumblr, 20.99% used Pinterest, 41.36% used Google, 27.57% used Yahoo, and 21.19% used another social media platform that was not listed on the survey.

Bivariate Regression Results

A bivariate regression analysis examined the association between the frequency of social media use and perceived stress (Table 2). Perceived stress was lower for the adolescents who visited social media sites several times a month in comparison to those who visited these sites several times a day ($b=-0.22$, $p = 0.0492$). Secondly, perceived stress was lower for those who visited these sites several times a week in comparison to those who visited several times a day ($b=-0.32$, $p = 0.0044$,). Thirdly, perceived stress was also lower for those who visited these sites approximately once a day in comparison

to those who visited several times a day (b=-0.34, p = 0.0002). This signifies that adolescents who used social network sites less frequently experienced lower levels of perceived stress than those who visited these sites more frequently. A bivariate regression analysis examined the association between the frequency of social media use and biological stress (Table 3). The findings indicated no significant relationships between hair cortisol and social media use for adolescents who visited social media sites several times a month (b= -0.11, p = 0.4989), several times a week (b=-0.16, p = 0.3529) or approximately once a day (b=0.01, p = 0.4055) in comparison to those that visited the sites several times a day.

Table 1: Descriptive characteristics of the sample (N=486)

	Mean (sd)	**% (n)**
Age	14.63 (1.75)	-----
Sex		
Male	-----	50.21 (244)
Female	-----	49.79 (242)
Race		
White	-----	57.82 (281)
Black/African American	-----	28.60 (139)
Mixed	-----	6.17 (30)
Hispanic/Latina	-----	3.50 (17)
Other	-----	2.06 (10)
Asian	-----	1.65 (8)
American Indian	-----	0.21 (1)
Dependent variables		
Perceived stress (range 1-5)	2.71 (0.74)	-----
Biological stress (hair cortisol)	5.33 (11.18)	-----

Table 2: Bivariate Regression Analysis between Frequency of Social Media Use and Perceived Stress	**b**	**pvalue**
Frequency of Social Media Use		
Several times a month vs several times a day	-0.22	0.0492
Several times a week vs several times a day	-0.32	0.0044
Once a day vs several times a day	-0.34	0.0002
Several times a day (reference)	----	

Table 3: Bivariate Regression Analysis between Frequency of Social Media Use and Biological Stress	**b**	**pvalue**
Frequency of Social Media Use		
Several times a month vs several times a day	-0.11	0.4989
Several times a week vs several times a day	-0.16	0.3529
Once a day vs several times a day	0.01	0.4055
Several times a day (reference)	----	

Discussion and Conclusion

This study analyzed the relationship between frequency of social media use and biological and psychological stress in adolescents. Biological stress was measured by hair cortisol and psychological stress was measured by a stress scale where the participants reported their perceptions. The results from the study suggest that less frequent social media use is associated with lower levels of perceived stress. These findings mirror past research findings that found social media use can have negative effects on adolescent mental health and wellbeing (Lin et al., 2016; Lissak, 2018), while contrasting others that have found that social media usage is associated with positive effects on adolescent mental health (Cotten et al., 2012; Kavetsos & Koutroumpis, 2011). Further research on the relationships between frequency of social media use and social media addiction is needed as increased use may be an indicator of addiction.

On the contrary to psychological stress, this study found nonsignificant associations between frequency of social media use and biological stress. This contrasts past studies that found increased social media use was associated with higher cortisol levels (Afifi, Zamanzadeh, Harrison, & Acevedo, 2018). A potential reason for the differential findings between the two stress measures may be due to the timing of the stress measure as the perceived stress measures asks about stress in the prior month while hair cortisol reflects a longer-term effect (up to 3 months) on the adolescents' physiology. Thus, adolescents' reports of perceived stress may have been influenced by more recent stressors.

Several limitations to the study warrant discussion. First, the study was a cross-sectional design and the relationship between increased social media use and perceived stress is not causal. In addition, descriptive and bivariate analyses were conducted for this study; multivariable analysis is needed to account for other factors related to social media use and/or the perceived and biological stress measures that might affect the significance of the relationship.

Despite these limitations, the results of this study suggest that increased frequency of social media use may increase perceived stress levels in adolescents and the findings are in alignment with some of the past research that found that social media use is associated with negative adolescent mental health. Social media usage in adolescents has drastically increased in the past decade, and it has become more easily accessible for adolescents to go on these sites. Taking measures to prevent adolescents from utilizing and accessing social media sites frequently could potentially decrease the risk of them experiencing an increased level of perceived stress. This study's findings suggest that

parents may need to monitor kids' social media use. Furthermore, setting certain limitations on their accessibility to these sites may also be beneficial to their mental health. Additionally, future research could consider demographic characteristics, such as gender, to see if there is a contrast in these findings for males and females. Lastly, future research may need to look at people's daily experiences on social media. The effect on stress may be variable depending on the quality of interactions adolescents have on these sites. The flexibility and freedom to access various content on social media allows people to have different interactions.

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